Support for Burned Area Debris Flow Forecasting Using VIIRS NDVI

Sam Batzli, Dave Parker, Russ Dengel, Nick Bearson
Space Science & Engineering Center, University of Wisconsin-Madison
Ivan Csiszar
NOAA/NESDIS – STAR
Katherine Rowden
NOAA/NWS – Spokane WFO

Summary

The Problem: National Weather Service forecasters need timely burn intensity estimates to help forecast mud and debris flows following large wildland fires.

Landsat-derived Burned Area Reflectance Classification (BARC) maps from the US Forest Service and US Geological Survey are the gold standard for burn intensity estimates, *but they are often not available for forecasting* debris flows in a timely manner.

This project is intended to develop a semi-automated method for getting burn intensity information into the hands of forecasters sooner by:

- Using VIIRS data for a quicker, lower resolution estimation
- Automating processing to lower latency
- Providing forecasters a web-based tool to initiate processing and collect GIS-ready results

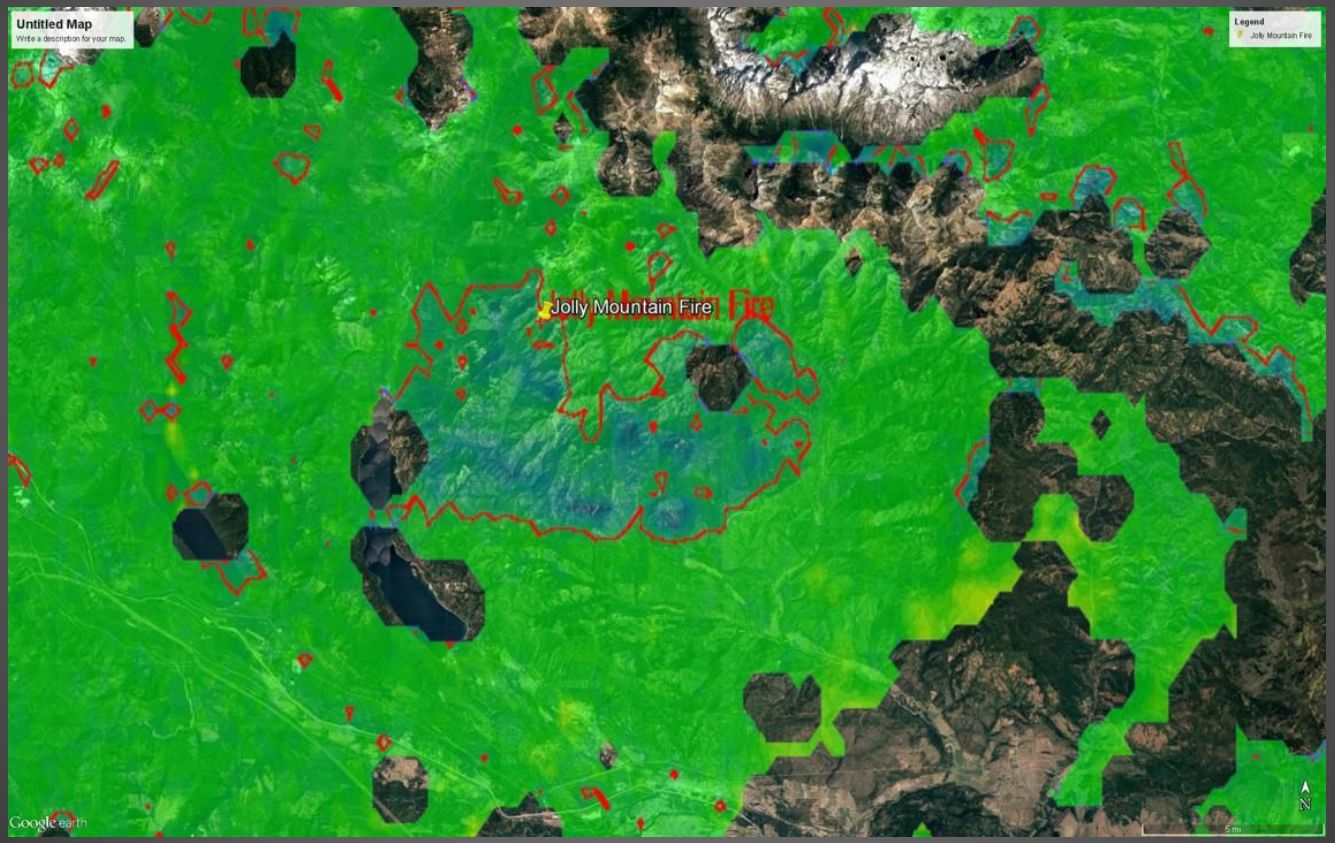
Results from Previous Research

Feasibility Studies: R. Bradley Pierce, Ivan Cisizar, Katherine Rowden

- Successful test of VIIRS Change in Normalized Difference Vegetation Index (Delta-NDVI) product to provide a rapid assessment of burn scars.
- The VIIRS Delta-NDVI imagery provided timely information when clear, high-resolution imagery was not available.
- Identified need for Esri shapefiles, suitable for GIS debris flow model processing.
- Desire to streamline, automate, extend, and ultimately operationalize production.

Results from Previous Research

Feasibility Studies: R. Bradley Pierce, Ivan Cisizar, Katherine Rowden



Jolly Mountain Fire: Difference between VIIRS NDVI on 20:43Z September 28, 2016 (pre-burn) and 20:41Z on September 26, 2017 (post-burn). Blue regions indicate reductions in NDVI following the Jolly Mountain Wildfire.

Results from Previous Research

Feasibility Studies: R. Bradley Pierce, Ivan Cisizar, Katherine Rowden

Norse Peak Fire: Difference between VIIRS NDVI on 20:43Z September 28, 2016 (pre-burn) and 20:41Z on September 26, 2017 (post-burn). Blue regions indicate reductions in NDVI following the Norse Peak Wildfire.

New Product

BRIDGE Maps: Burn Intensity Delta Greenness Estimation

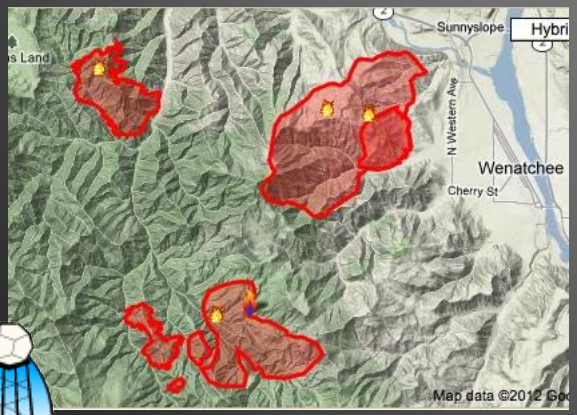
- BARC product is not intended to be used as an early warning tool.
- BRIDGE product will supplement, not replace BARC.
- BRIDGE product will evaluate NDVI from TOA (top of atmosphere), NDVI from TOC (top of canopy), and EVI (Enhanced Vegetation Index) from TOC in its production.
- BARC product is developed as a Delta NBR (Normalized Burn Ratio).
- NBR is not available as an operational and routinely produced VIIRS product at this time.
- This project will explore and test the potential for utilizing VIIRS NBR as well.

Integration of BRIDGE will result in improved situational awareness and will support decision making, especially before BAER assessment teams can deploy (typically at 80% containment) or before BARC maps are available.

Historical Analysis

We are testing BRIDGE maps for historical Washington debris flow events that followed fires and also mapping fires from the past two years.

- 6/29/2013 **2012 Peavine Fire**
  - year after, so there was a BAER assessment
- 8/4/2013 **2012 Wenatchee Fire**
  - year after, so there was a BAER assessment
- 8/13/2013 **2013 Colockum Tarps Fire**
  - fire was still active, no BARC or BAER
- 8/21/2014 **2014 Carlton Complex**
  - fire was still active, no BAER team yet, there was a BARC, but it was not widely shared



Workflow for Automated VIIRS Burn Intensity Estimation:

Satellite Inputs for Flash Flood and Debris Flow Situational Awareness and Modeling

Dashboard Displays:
- Satellite Active Fire Locations
- VIIRS Imagery/NDVI/EVI
- Embedded RealEarth Map

1

Web-Based Dashboard

NWS-WFO Initiates Action

NWS-WFO Staff:
- Chooses Fire(s) to Analyze
- Inspects Imagery
- Selects Before/After NDVI/EVI Pairs

4

NWS-WFO Integration

Adding VIIRS-Derived BRIDGE Product

Decision Support:
- Integration for Situational Awareness
- NWS-WFO & IMETs Utilize BRIDGE for Decision Support and Warnings as Necessary

3

Results Visualized on Dashboard

Available for Download or Streaming

Dashboard Adds:
- BRIDGE Map
- Download/Streaming (multiple GIS formats)
- Added to Embedded RealEarth Map

2

Server Processing

Delta Greenness for Before and After Pairs

Processing:
- Before/After Pairs are Processed
- Burn Intensity Delta Greenness Estimation
- (BRIDGE) Map Produced in GIS Format

Summary of Tasks

Component 1: Web-Based Dashboard with RealEarth Map

Embedded map with True/False color VIIRS imagery, NDVI, Active Fires, Cloud Mask, Current Large Fires, Burn Scar Maps, drop-down menus and drawing tools for user to select area of interest for analysis.

Component 2: Historical Fire Analysis

Run protocol with historical fires/burn scars that led to debris flow events. Produce BRIDGE maps for large fires in recent years.

Component 3: Image Processing initiated by NWS-WFO

Automate Delta-NDVI BRIDGE map production. Link dashboard controls to automated processing on dedicated server at UW-CIMSS.

Component 4: Results Visualized on Dashboard

Automate process of scaling and converting raster output to polygon Shapefile and GeoJSON for use in GIS. Display in Dashboard.

Component 5: Results Integrated into NWS-WFO Models

Evaluate effectiveness of BRIDGE maps in debris flow forecast models.

Component 1 Progress